Amendments to the Claims

The following Listing of Claims replaces all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (currently amended): A vertical cavity surface emitting laser (VCSEL) operable to generate single-mode laser light at an operative wavelength, comprising:

a light-emitting surface; and

a monolithic longitudinal stack structure including

a first mirror having an optical reflectivity R1 for light at the operative wavelength,

a second mirror having an optical reflectivity R2 for light at the operative wavelength, wherein R1 and R2 have different respective values one of which is greater than 99.9% and another of which is less than 99.7%,

a cavity region ~~disposed between~~extending from the first mirror ~~and~~to the second mirror and including an active light generation region and a cavity extension region;

wherein the longitudinal stack structure further includes an ion-implanted current confinement region characterized by a peak longitudinal implant concentration separated from the cavity region by a longitudinal distance greater than 0.5 μm.

Claim 2 (original): The VCSEL of claim 1, further comprising a metal contact disposed on the light emitting surface and defining an aperture, wherein the ion-implanted current confinement region defines a current aperture larger than the aperture of the metal contact.

Claim 3 (original): The VCSEL of claim 1, wherein both R1 and R2 are at least 99.5%.

Claim 4 (original): The VCSEL of claim 1, wherein the cavity extension region has a longitudinal optical thickness greater than twice the operative wavelength.

Claim 5 (previously presented): The VCSEL of claim 4, wherein the longitudinal optical thickness of the cavity extension region is less than about twenty times the operative wavelength.

Claim 6 (original): The VCSEL of claim 1, wherein each of the first and second mirrors comprises a respective stack of alternating layers of different refractive index materials each having a longitudinal optical thickness substantially equal to one-quarter of the operative wavelength, and the cavity region without the cavity extension region has a longitudinal optical thickness substantially equal to the operative wavelength.

Claim 7 (original): The VCSEL of claim 6, wherein the cavity extension region is adjacent to one of the alternating layers of the first and second mirrors.

Claim 8 (previously presented): The VCSEL of claim 4, wherein the longitudinal optical thickness of the cavity extension region is substantially equal to an integral multiple of one-half the operative wavelength.

Claim 9 (previously presented): The VCSEL of claim 4, wherein the cavity extension region is disposed adjacent to the second mirror and has the same material composition as one of the different refractive index materials in the second mirror stack.

Claim 10 (previously presented): The VCSEL of claim 4, wherein the cavity extension region is disposed between the active light generation region and the second mirror.

Claim 11 (previously presented): The VCSEL of claim 4, wherein a first portion of the cavity extension region is adjacent to the first mirror and second portion of the cavity extension region is adjacent to the second mirror.

Claim 12 (original): The VCSEL of claim 1, wherein the ion-implanted current confinement region is characterized by a longitudinal straggle and the peak longitudinal implant

concentration is separated from the cavity region by a longitudinal distance greater than three times the longitudinal straggle.

Claim 13 (original): The VCSEL of claim 1, wherein the current confinement region defines a current aperture with a diameter of less than 12 micrometers.

Claim 14 (original): An array of two or more vertical cavity surface emitting lasers (VCSELs), each VCSEL comprising:

a light-emitting surface; and

a monolithic longitudinal stack structure including

a first mirror having an optical reflectivity R1 for light at the operative wavelength,

a second mirror having an optical reflectivity R2 for light at the operative wavelength, wherein R1 and R2 have different respective values one of which is greater than 99.9% and another of which is less than 99.7%,

a cavity region disposed between the first mirror and the second mirror and including an active light generation region and a cavity extension region;

wherein the longitudinal stack structure further includes an ion-implanted current confinement region characterized by a peak longitudinal implant concentration separated from the cavity region by a longitudinal distance greater than 0.5 μm.

Claim 15 (currently amended): A method of manufacturing a vertical cavity surface emitting laser (VCSEL), comprising:

forming a light-emitting surface and a monolithic longitudinal stack structure, the monolithic longitudinal stack structure including

a first mirror having an optical reflectivity R1 for light at the operative wavelength,

a second mirror having an optical reflectivity R2 for light at the operative wavelength, wherein R1 and R2 have different respective values one of which is greater than 99.9% and another of which is less than 99.7%,

a cavity region ~~disposed between~~extending from the first mirror ~~and~~ to the second mirror and including an active light generation region and a cavity extension region;

implanting ions in an current confinement region characterized by a peak longitudinal implant concentration separated from the cavity region by a longitudinal distance greater than 0.5 μm.

Claim 16 (original): The method of claim 15, further comprising forming on the light emitting surface a metal contact defining an aperture, wherein the ion-implanted current confinement region defines a current aperture larger than the aperture of the metal contact.

Claim 17 (original): The method of claim 15, wherein the cavity extension region has a longitudinal optical thickness greater than twice the operative wavelength and less than about twenty times the operative wavelength.

Claim 18 (original): The method of claim 15, wherein each of the first and second mirrors comprises a respective stack of alternating layers of different refractive index materials each having a longitudinal optical thickness substantially equal to one-quarter of the operative wavelength, and the cavity region without the cavity extension region has a longitudinal optical thickness substantially equal to the operative wavelength.

Claim 19 (previously presented): The method of claim 18, wherein the longitudinal optical thickness of the cavity extension region is substantially equal to an integral multiple of one-half the operative wavelength.

Claim 20 (previously presented): The method of claim 18, wherein the cavity extension region is disposed adjacent to the second mirror and has the same material composition as one of the different refractive index materials in the second mirror stack.

Claim 21 (previously presented): The VCSEL of claim 1, wherein the current confinement region is a damaged region of the longitudinal stack structure.

Claim 22 (previously presented): The method of claim 15, wherein the implanting comprises implanting protons in the current confinement region.

Claim 23 (new): The VCSEL of claim 1, wherein the ion-implanted current confinement region is in the first mirror.

Claim 24 (new): The method of claim 15, wherein the implanting comprises implanting protons in the first mirror.

Claim 25 (new): The array of claim 14, wherein the cavity region extends from the first mirror to the second mirror.